

Temporal and spatial geochemical evolution of volcanic rocks from northern Kyushu, Southwest Japan

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Temporal and spatial changes in the geochemistry of Cenozoic volcanic lavas from northern Kyushu (ca. 10 Ma to 0.5 Ma), southwest Japan, provide insight into the nature of upper mantle and reflect the magmatic evolution of lithosphere-asthenosphere interactions during lithosphere thinning. Here we present the comprehensive geochemical and Sr-Nd-Pb-Hf isotopic compositions of the volcanic rocks from northern Kyushu. The northern Kyushu volcanic rocks can be divided into three series based on major and trace element abundances: alkali basalt, sub-alkali basaltic rocks, and High Mg andesite (HMA). The Alkali basalts in northern Kyushu have trace elements distribution patterns similar to oceanic island basalts (OIB), suggesting asthenospheric sources within the convecting upper mantle. The sub-alkali basaltic rocks and HMA in northern Kyushu have incompatible element ratios that differ from OIB. The compositions range from OIB-like patterns depleted in HFS elements to strongly depleted patterns similar to those of subduction-related island arc basalt. Their isotopic compositions change systematically through time and spatial distribution. The geochemical variations among alkali basalt, sub-alkali basaltic rocks and HMA cannot be accounted for by crustal assimilation, and are best interpreted as an indication of interaction of asthenospheric-derived alkali basaltic magma with overlying heterogeneous lithospheric mantle. This mantle can be divided into two series: one is characteristically more depleted in Sr-Nd-Hf isotopic compositions and the other isotopically enriched in these isotopic compositions and showing affinities with an EM-II source. The temporal and spatial changes in the geochemical compositions show support for the inferred mantle geochemical stratigraphy. These changes might have been controlled by interaction of geochemically heterogeneous upwelling mantle with lithospheric mantle thinning in an extensional regime, possibly associated with the opening of the Sea of Japan and rifting of the northern part of the Okinawa Trough.